Long-term Source apportionment of ambient $PM_{2.5}$ in the Los Angeles Basin: a focus on emissions reduction from vehicular sources

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Positive Matrix Factorization (PMF) was utilized to identify and quantify sources of PM2.5 in central Los Angeles (LA) and Rubidoux, using the Speciation Trends Network (STN) data, collected between 2002 and 2013. Vehicular emissions (including both gasoline and diesel vehicles) were found to be the second major contributor to PM2.5, following secondary aerosols, with a near 20% contribution to total mass in both sites. During 2002 to 2004, the median and annual average values of vehicular emissions were relatively constant at both sites. Their contributions peaked in 2007 and 2005, respectively in LA and Rubidoux, while trended downward afterward until 2013. In 2013, the median values of daily-resolved vehicular emissions source contributions in LA and Rubidoux were respectively 70 and 52% lower than their corresponding values in 2007 and 2005. Starting in 2007, all manufactured diesel trucks must meet the EPA 2007 emission standard, requiring a 90% reduction in their PM emissions. Moreover, after 2007, several major steps were taken by the California Air Resources Board and the ports of LA and Long Beach to reduce emissions from vehicular sources, particularly from diesel trucks. To assess the effect of these regulations, daily-resolved vehicular emissions source contributions from 2002 to 2006 were pooled together and compared to the combination of 2008 to 2012 datasets. Compared to 2002-2006 dataset, the median values of vehicular emissions in 2008-2012 statistically significantly ($p \leq 0.001$) decreased by 24 and 21% in LA and Rubidoux, respectively. These reductions were noted despite an overall increase (about 5%) in the median value of the daily flow of vehicles in downtown LA after 2007, while the traffic counts were comparable before and after 2007 in Rubidoux. Overall, our findings demonstrate the effectiveness of stringent regulations in reducing PM emissions from vehicular sources in the LA basin over the past decade.